

PERIODIC TABLE

reflect

Suppose you wanted to organize your locker at school. How could you separate and arrange everything in an organized way? You could place the books, notebooks, and folders on a shelf that is separate from the pencils, pens, and erasers. You might order the books from smallest to largest with the notebooks and folders on the end. Or you might arrange the books and folders by subject.



Scientists use properties to organize things, too. The elements are organized in a specific way on the Periodic Table of Elements (Periodic Table for short). What properties do scientists use to organize the Periodic Table? What does this tell us about the elements?

Atomic Number

Elements are organized on the Periodic Table according to atomic number. The *atomic number* of an element refers to the number of protons in the nucleus of that atom. Each atom of an element always has the same number of protons, therefore, the same atomic number. Here is a version of the Periodic Table.

Periodic Table of Elements																																															
1A																		8A																													
1																		2																													
H																		He																													
1.008																		4.002																													
2A																		3A		4A		5A		6A		7A																					
3		4																5		6		7		8		9		10																			
Li		Be																B		C		N		O		F		Ne																			
6.941		9.0121																10.811		12.010		14.006		15.999		18.998		20.179																			
11		12																13		14		15		16		17		18																			
Na		Mg																Al		Si		P		S		Cl		Ar																			
22.989		24.305																26.981		28.085		30.957		32.065		35.453		39.948																			
19		20		21		22		23		24		25		26		27		28		29		30		31		32		33		34		35		36													
K		Ca		Sc		Ti		V		Cr		Mn		Fe		Co		Ni		Cu		Zn		Ga		Ge		As		Se		Br		Kr													
39.098		40.078		44.955		47.867		50.941		51.996		54.938		55.845		58.933		58.693		63.546		65.409		69.723		72.64		74.921		78.96		79.904		83.798													
37		38		39		40		41		42		43		44		45		46		47		48		49		50		51		52		53		54													
Rb		Sr		Y		Zr		Nb		Mo		Tc		Ru		Rh		Pd		Ag		Cd		In		Sn		Sb		Te		I		Xe													
85.467		87.62		88.905		91.224		92.906		95.94		98		101.07		102.905		106.42		107.868		112.411		114.818		118.710		121.760		127.60		126.904		131.293													
55		56		57-71		72		73		74		75		76		77		78		79		80		81		82		83		84		85		86													
Cs		Ba				Hf		Ta		W		Re		Os		Ir		Pt		Au		Hg		Tl		Pb		Bi		Po		At		Rn													
132.905		137.327				178.49		180.947		183.84		186.207		190.23		192.217		195.078		196.966		200.59		204.383		207.2		208.980		209		210		222													
87		88		89-103		104		105		106		107		108		109		110		111		112		113		114		115		116		117		118													
Fr		Ra				Rf		Db		Sg		Bh		Hs		Mt		Ds		Rg		Cn		Uut		Uuq		Uup		Uuh		Uus		Uuo													
223		226				261		262		266		264		277		268		271		271		285																									
Lanthanide series																		57		58		59		60		61		62		63		64		65		66		67		68		69		70		71	
																		La		Ce		Pr		Nd		Pm		Sm		Eu		Gd		Tb		Dy		Ho		Er		Tm		Yb		Lu	
																		138.905		140.116		140.907		144.24		145		150.36		151.964		157.25		158.925		162.500		164.930		167.259		168.934		173.04		174.967	
Actinide series																		89		90		91		92		93		94		95		96		97		98		99		100		101		102		103	
																		Ac		Th		Pa		U		Np		Pu		Am		Cm		Bk		Cf		Es		Fm		Md		No		Lr	
																		227		232.038		231.035		238.028		237		244		243		247		247		251		252		257		258		259		262	

PERIODIC TABLE

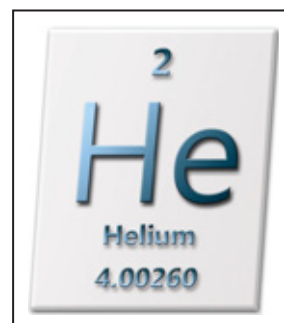
Moving across (left to right) each row of the Periodic Table, the atomic number increases sequentially (in order.) For example, the atomic number of carbon (C) is 6 and the atomic number of nitrogen (N) is 7. These two elements are next to each other in the second row of the Periodic Table. Cesium (Cs) has an atomic number of 55 and Barium has an atomic number of 56. They are found next to each other in the sixth row. The atomic number increases as you go to the right across and as you go down the Periodic Table.

Atomic Mass

Because elements are arranged according to their atomic number, the atomic mass of each element also increases when moving to the right and down the Periodic Table. *Atomic mass* is the average mass of one atom of an element.

look out!

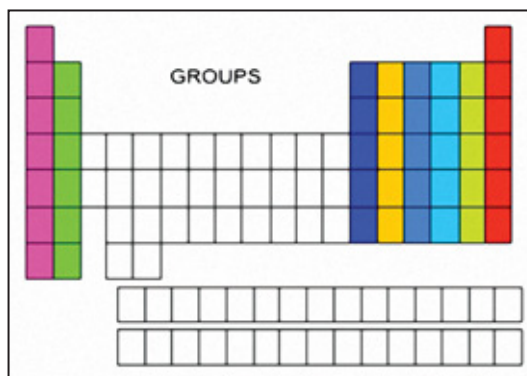
As you move across the Periodic Table from left to right, the atomic number of each element increases by one. Typically, this number is written as a whole number above the *chemical symbol* (the one- or two-letter code that represents an element). Be careful not to confuse this with the number below the chemical symbol, which is the atomic mass. Take a look at the illustration on the right. The element helium (He) has an atomic number of 2, which is the number above the symbol He. The average atomic mass of helium is 4.00260. The average atomic mass is written below the He symbol.



Groups and Periods

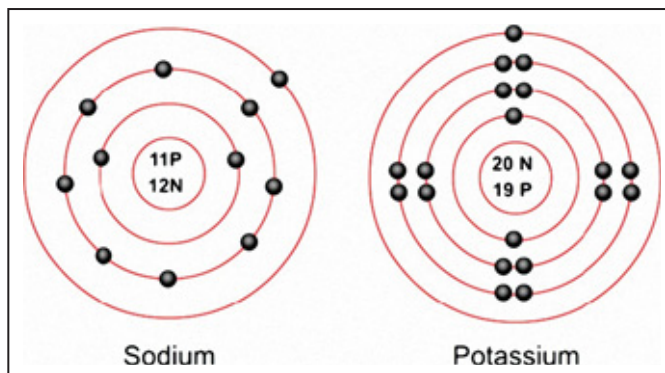
There are additional patterns of arrangement on the Periodic Table. The vertical columns are known as *groups*. If you look at the Periodic Table on the previous page, you will notice that numbers and letters are used to identify groups. For example, the first group from the left is 1A. Elements in the same group have the same number of valence electrons. *Valence electrons* are the electrons in the outer energy level. They determine the chemical behavior of an element. So, elements in the same group have similar chemical properties because they have the same number of valence electrons. There are some exceptions to this order. These exceptions are shown by the un-shaded elements in the diagram at the right.

Let's discuss the elements in the first column, or group 1A, of the Periodic Table. Each element in this group has one valence electron. Sodium (Na) and potassium (K) are two elements in this group.



PERIODIC TABLE

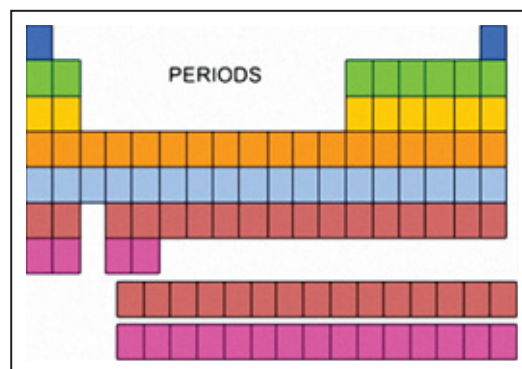
The electron arrangements of these two elements are shown in the figures below. These elements are metals and tend to donate their single valence electron to other elements in order to have a full outer energy level. The other elements in this group also tend to donate their single valence electron.



Elements in other groups also have the same number of valence electrons as other elements in that group. For example, elements in the second column, or group, have two valence electrons and tend to donate these two electrons. Elements in group 17, the second to last column from the left, have seven valence electrons. They need one electron to fill their outer energy level. They tend to react with other elements to gain one electron. Alternatively, the elements in the last column are known as the *noble gases*. These elements have a complete outer energy level, so they tend to keep their electrons and are very stable elements. They do not react easily with other elements.

You learned earlier in the lesson that atomic number increases as you move from left to right across rows and down the rows of the Periodic Table. These rows are called *periods* and they correspond to the number of energy levels in an element. Energy levels are the different orbits in which electrons move around the center of an atom. For example, every element in the top row (first period) has the same number of energy levels. This period contains only two elements, hydrogen (H) and helium (He).

These elements have only one energy level. The elements in the second period (Li, Be, B, C, N, O, F, and Ne) have two energy levels. This pattern continues as you move down the rows of the Periodic Table.



PERIODIC TABLE

The arrangement of elements in the Periodic Table is based on atomic number, reactivity and valence electrons allows you to predict reactivity and behavior of elements based on their locations on the table.

what do you think?

Take a look at the diagram below. For each element, identify the group and period to which each element belongs. Use a Periodic Table for reference. What can you determine about each element based on its location on the Periodic Table?

Hydrogen 1 H 1.00794	Carbon 6 C 12.011	Oxygen 8 O 15.9994
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Metals, Non-metals, and Metalloids

Because elements are arranged on the Periodic Table according to similar chemical properties, three main types of elements are arranged in a pattern on the table as well. The three main types are metals, non-metals, and metalloids.

Most of the elements on the Periodic Table are metals. Metals are usually shiny solids that are malleable and ductile. They are good conductors of heat and electricity. Examples include gold (Au), iron (Fe), lead (Pb), and silver (Ag.) The metals are shaded in gray on the Periodic Table on the next page.

Non-metals are typically dull and brittle. Brittle materials break or crack easily. Non-metals are generally poor conductors of heat and electricity. There are only 18 non-metals on the Periodic Table, including hydrogen (H), carbon (C), and nitrogen (N.) The non-metals are un-shaded (white) on the Periodic Table on the next page.

Metalloids have properties of both metals and non-metals. Some metalloids have a metallic luster, such as silicon (Si). Silicon is also brittle; therefore, it has characteristics of both the metals and the non-metals. Some metalloids are semi-conductors, meaning they carry an electrical charge under certain conditions. The metalloids are located along the “steps” that separate metals from non-metals on the Periodic Table. They are shaded orange on the Periodic Table on the next page.

PERIODIC TABLE

1A

1

Hydrogen

H

2A

3

Lithium

Li

4

Beryllium

Be

11

Sodium

Na

12

Magnesium

Mg

19

Potassium

K

20

Calcium

Ca

37

Rubidium

Rb

38

Strontium

Sr

55

Cesium

Cs

56

Barium

Ba

87

Francium

Fr

88

Radium

Ra

3B

4B

5B

6B

7B

8B

9B

10B

11B

12B

28

31

32

33

34

35

36

49

50

51

52

81

82

83

84

85

86

113

114

115

116

117

118

5B

6B

7B

8B

9B

10B

11B

12B

28

31

32

33

34

35

36

49

50

51

52

81

82

83

84

85

86

113

114

115

116

117

118

3A

4A

5A

6A

7A

8A

5

Boron

B

6

Carbon

C

7

Nitrogen

N

8

Oxygen

O

9

Fluorine

F

10

Neon

Ne

13

Aluminum

Al

14

Silicon

Si

15

Phosphorus

P

16

Sulphur

S

17

Chlorine

Cl

18

Argon

Ar

32

Germanium

Ge

33

Arsenic

As

34

Selenium

Se

35

Bromine

Br

36

Krypton

Kr

50

Tin

Sn

51

Antimony

Sb

52

Tellurium

Te

82

Lead

Pb

83

Bismuth

Bi

84

Polonium

Po

85

Astatine

At

86

Radon

Rn

112

Copernicium

Cn

113

Ununtrium

Uut

114

Flerovium

Fl

115

Ununpentium

Uup

116

Livermorium

Lv

117

Ununseptium

Uus

118

Ununoctium

Uuo

1

Atomic Number

Hydrogen

Chemical Name

H

Chemical Symbol

KEY

Non metals

Metalloids

Metals

Lanthanides

58

Cerium

Ce

59

Praseodymium

Pr

60

Neodymium

Nd

61

Promethium

Pm

62

Samarium

Sm

63

Europium

Eu

64

Gadolinium

Gd

65

Terbium

Tb

66

Dysprosium

Dy

67

Holmium

Ho

68

Erbium

Er

69

Thulium

Tm

70

Ytterbium

Yb

71

Lutetium

Lu

Actinides

90

Thorium

Th

91

Protactinium

Pa

92

Uranium

U

93

Neptunium

Np

94

Plutonium

Pu

95

Americium

Am

96

Curium

Cm

97

Berkelium

Bk

98

Californium

Cf

99

Einsteinium

Es

100

Fermium

Fm

101

Mendelevium

Md

102

Nobelium

No

103

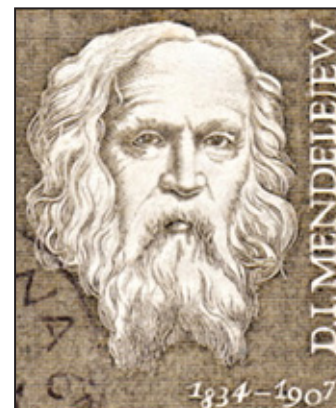
Lawrencium

Lr

Discover Science: Development of the Periodic Table

In the 1800s, a professor named Dmitri Mendeleev developed one of the first tables to arrange the elements. First, Mendeleev ordered the elements by increasing atomic mass, and then further separated them based on their chemical properties. This work was the basis for our current Periodic Table of Elements. At the time, there were only 63 known elements. However, Mendeleev was able to theorize about new elements, which were identified after his table of the elements was created.

In the years following Mendeleev's development, the elemental table was revised slightly. A scientist named Henry Moseley ordered the elements based on atomic number. This is the current method in which the elements are ordered.



PERIODIC TABLE

What do you know?

The Periodic Table of Elements is arranged based on the properties of elements. The chart below lists five elements. For each element, find a “matching” element in the box below the chart. A matching element is one that is in either the same group or the same period as the element in the chart. Then, write whether the elements are in the same group or the same period. Finally, write at least two characteristics that are shared by the matching elements based on their locations on the Periodic Table. You will need to refer to a Periodic Table to complete this activity.

Element	Matching Element	Matching Group or Period?	Shared Characteristics
Calcium (Ca)			
Flourine (F)			
Iodine (I)			
Argon (Ar)			

- Oxygen (O)
- Neon (Ne)
- Magnesium (Mg)
- Xenon (Xe)

connecting with your child

Organization of the Periodic Table

To help your child learn more about the Periodic Table, work together to create an “element” game. For this activity, you or your child will need to make 10 flash cards. You will also need a copy of a Periodic Table, which can be found in science textbooks or on the Internet.

Decide who will be the “reader” and who will be the “guesser.” The reader should spend some time making the flash cards by choosing 10 elements and writing information about each element on a single card. On one side of the card, write the chemical symbol for the element. On the other side, describe its location on the Periodic Table (group and period), its atomic mass, and its classification as a metal, non-metal, or metalloid. This information is to help the reader answer the questions asked by the guesser.

Have the reader choose a flash card to start the game. Make sure the guesser does not see the card. The guesser should begin by asking a series of questions until he or she correctly guesses the element. The only questions the guesser may ask are those that require a “yes” or “no” answer. For example, the guesser could ask, “Is the element a metal?” The guesser cannot ask, “What is the atomic number of the element?” Make sure the copy of the Periodic Table is available for the reader to use as a reference during the game.

Here are some questions to discuss with your child after you play the game:

- Which questions were most helpful to the guesser in identifying the element on each flash card?
- Were there any questions that were not helpful? If so, what were they?
- How does organizing the elements help scientists use the Periodic Table?